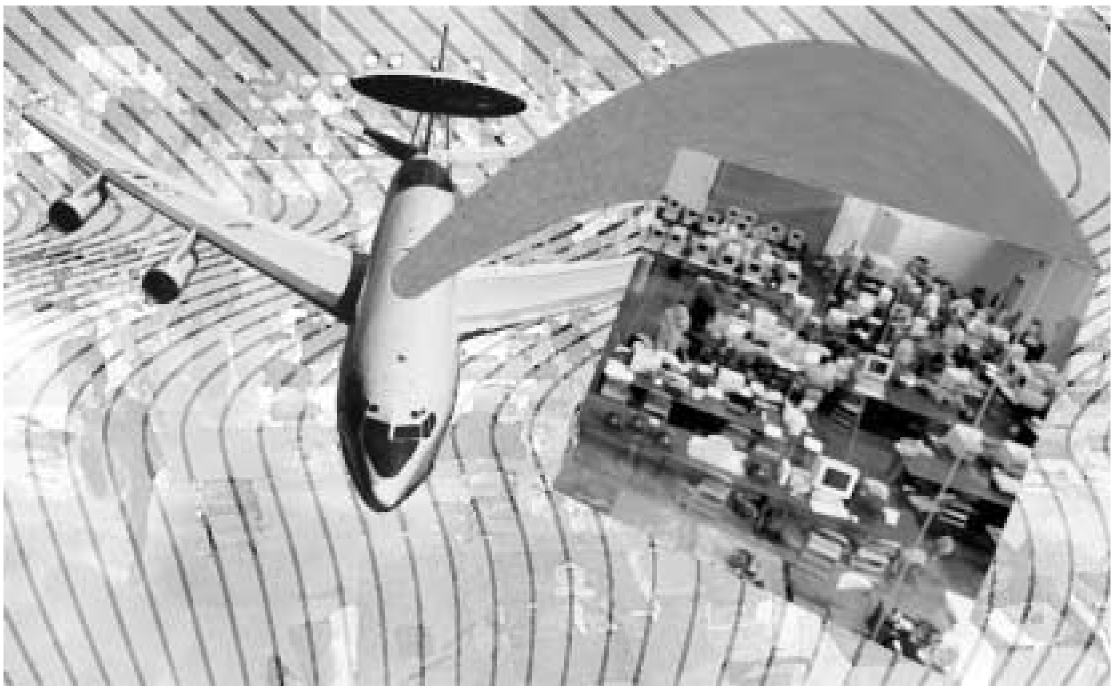
Transforming Warfare with Effects-Based Joint Operations

LT COL PRICE T. BINGHAM, USAF, RETIRED



Editorial Abstract: What used to be science fiction is becoming reality. Command, control, intelligence, surveillance, and reconnaissance (C^2ISR) technology has so progressed that it may soon be possible to direct warfare in real time from or through C^2ISR platforms. Colonel Bingham introduces such a concept of effects-based joint operations that would give commanders in chief unprecedented control of the battle space and enable realistic training of command and battle staffs via something called advanced distributed simulation.

THE QUADRENNIAL DEFENSE Review can transform warfare and dramatically increase strategic options across a range of threats, from theater war to stability operations, by recommending that the military services train and equip their forces to conduct effects-based joint operations. Such operations would transform warfare by using a theater team of airborne command, control, intelligence, surveillance, and reconnaissance (C^2ISR) systems to manage the decentralized execution of US aerospace sorties (of the Air Force, Navy, Marine Corps, and Army) for targeting enemy land forces. Key to the transformation would be the use of friendly (not necessarily

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **2001**	2. REPORT TYPE	3. DATES COVERED **00-00-2001 to 00-00-2001**
4. TITLE AND SUBTITLE **Transforming Warfare with Effects-Based Joint Operations**		5a. CONTRACT NUMBER
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air and Space Power Journal,155 N. Twining Street,Maxwell AFB,AL,36112-6026**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**9**	

US) land maneuver to support this asymmetrical engagement of enemy land forces. The transformation is possible because advances in wide-area, real-time airborne ground-surveillance and battle-management systems make it feasible for air attacks to create physical and psychological "effects" that combine to quickly prevent a fielded land force from functioning well enough to achieve its desired objectives. Effects-based joint operations would increase strategic options by permitting US personnel to achieve success faster, more efficiently, and with less risk than is possible in operations that depend primarily on physical attrition and the close battle to defeat enemy land forces.

Importance of the C²ISR Team

The unprecedented airborne surveillance and battle-management capabilities provided by a theater C²ISR team consisting of joint surveillance, target attack radar system (JSTARS); airborne warning and control system (AWACS); and Rivet Joint aircraft make effects-based joint operations possible. The team possesses the advantages of powerful, wide-area sensors; line-of-sight communications with most combatants; and, most importantly, large crews needed for the real-time management of both surveillance and target attacks. The C²ISR team's combination of surveillance and surveillance-management capabilities is the key to achieving dominant battle-space awareness. The team's battle-management capabilities make it feasible to exploit this awareness in real time to achieve the functional effect of paralysis by targeting air attacks against machines operated by the enemy.

The C²ISR team enhances US expeditionary capabilities because it and the aircraft for which it targets (fighters, bombers, and armed helicopters) can quickly self-deploy to a distant theater. The team also enhances these capabilities by dramatically reducing and, in some scenarios, even eliminating the need for US land forces to engage powerful enemy army units in close combat. This complements the Army's "medium-weight" combat-unit transformation initiative by allowing US land forces to deploy quickly and maneuver rapidly after their arrival in-theater.

The C²ISR team reduces or eliminates close-combat requirements in several ways. Air attacks managed by the team make it possible to halt powerful enemy units before they can move close enough to friendly land forces to effectively employ their organic weapons. These attacks also create an important maneuver advantage for our land forces by allowing them to avoid close combat in other-than-ideal conditions because enemy forces subject to air attack cannot, or are unwilling to, move quickly. Furthermore, the C²ISR team provides real-time information needed by US commanders to maneuver their land forces most effectively.

Achieving and Exploiting Dominant Battle-Space Awareness

The C²ISR team achieves dominant battle-space awareness by exploiting an army's dependence on movement and machines. Throughout the history of warfare, effective army commanders have orchestrated the movement of their forces to create the advantages of superior force ratios, favorable positions, surprise, and protection. During the twentieth century, technology in the form of motorized vehicles transformed the conduct of land warfare at both the operational (campaign) and tactical (battlefield) levels by greatly enhancing the ability of armies to move combat forces and their logistical support. Today, all but the most primitive armies rely heavily on vehicles to perform a variety of critically important military functions such as maneuvering, targeting (with radar-equipped vans), delivering heavy firepower, protecting (through armor and movement), constructing, communicating (carrying heavy radios), and resupplying.

It is difficult to conceive of an opposing army attempting a powerful, high-tempo land offensive without using thousands of vehicles because of the many important functions they

perform in the conduct of land warfare. Given the vulnerability of fixed facilities, the antiaccess capabilities employed to protect such an offensive would also likely make extensive use of vehicles. Even internal-oppression operations rely heavily on vehicles. For example, as was the case with such operations in Iraq, large numbers of vehicles with army artillery and tank support provided protection for operations by Serb paramilitary forces in the Balkans.

The C^2ISR team's unprecedented surveillance and surveillance-management capabilities take advantage of the central role that movement and machines play in modern land warfare to provide and exploit dominant battle-space awareness. The role of machines makes it difficult for an enemy to counter effects-based joint operations. For example, if an enemy avoids using his machines, he loses all the advantages they provide, rendering his forces much less capable of aggression and making them extremely vulnerable to defeat by forces able to use their own machines. People familiar with the advantages machines provide understand why the North Vietnamese increased their reliance on them throughout the war in Southeast Asia and why mechanized units were among the last US Army forces withdrawn. Contrary to the myth that bicycles sustained the North Vietnamese, they devoted a huge effort to making the Ho Chi Minh Trail capable of handling an increasingly large volume of truck traffic.

The C^2ISR team's sensors "see" machines in real time whenever they move or emit within a wide area, even in darkness and adverse weather. By cross-cueing each other's sensors, as well as those on unmanned aerial vehicles (UAV) and other surveillance platforms, and then correlating the collected information, the team can quickly and reliably detect, precisely locate, and accurately characterize an enemy's machines. (The team could further enhance this information by using geo-filtered and identification-filtered friendly location and status information to create a composite display of forces essential for reducing the risk of fratricide.) The team can then quickly and securely disseminate its information to a joint force commander (JFC), the component commanders, and their subordinate echelons to ensure that everyone shares the same real-time situational awareness.

The C^2ISR team's ground moving-target indicator (GMTI) radar surveillance plays an especially important role in achieving and then exploiting dominant battle-space awareness. This radar allows the team to collect persistent, real-time information on both enemy and friendly vehicular movement within a large area, even during adverse weather and darkness. In many cases, GMTI information would be the key to cueing when and where to employ smaller-field-of-view but higher-resolution sensors, such as those carried by UAVs and U-2s, that provide positive target identification.

Our experience in Kosovo, as well as exercises, shows that GMTI cueing enhances battle-space awareness by making UAVs much more efficient, effective, and survivable. Specifically, cueing these aircraft on when and where to look for enemy activity can significantly reduce wasted surveillance time. Cueing can also increase UAVs' effectiveness since targets have less warning time to employ countermeasures such as smoke. Finally, GMTI increases the survivability of UAVs by reducing their loiter time in target areas and thus decreases their exposure to point air defenses.

Why Dominant Battle-Space Awareness Makes Transformation Possible

Dominant battle-space awareness makes transformation possible by rendering obsolete an assumption that close combat should play the major role in the defeat of enemy land forces. Without dominant battle-space awareness, commanders (and war-fighting models) had to assume that information on the location and strength of individual enemy army units would not be reliable or precise. This assumption proceeded from major limi-

tations in the ability to collect and process data on an enemy's mobile land forces, exploit that data into information, and then disseminate that information to war fighters fast enough to support dynamic targeting and land maneuver.

The information problem was caused by the fact that most ground-surveillance systems had to be very close to their coverage area; that sensors had restricted fields of view and needed daylight and / or good visibility to operate properly; and that a system had difficulty providing persistent coverage. Systems that could operate in adverse weather could not see, let alone precisely track, slow-moving land vehicles; moreover, camouflage, concealment, and deception (CCD) measures degraded the effectiveness of many of these systems. After collecting data, many systems had to return to base to convert it into useful information. When finally available, the surveillance information still had to be disseminated. This entire process took precious time, during which enemy mobile forces continued to move, rendering a commander's information on them, collected by ground-surveillance systems, increasingly unreliable.

Without reliable information on opposing army forces, commanders often depended on actual contact (close combat) to determine an enemy's location, strength, and intentions. British military theorist B. H. Liddell Hart explained the role of close combat in locating an enemy with his "man-in-the-dark" theory of infantry tactics that compared land combat to two men fighting hand to hand in a dark room. Given the problems involved in finding enemy forces, success often depended on fielding large, powerful, heavy land forces and fighting a campaign whose tempo was restricted by the immense logistical problems associated with the use of such forces.

The Role of Danger and Jointness in Effects-Based Joint Operations

Conducting effects-based joint operations requires that the JFC direct the joint force air component commander (JFACC) to employ precision engagement to paralyze the enemy land force and minimize its ability to engage friendly land forces in close combat. The JFACC would design counterland operations to apply deterrence theory at the tactical and operational levels. The objective would entail targeting vehicular movement in order to create such "shock and awe" that surviving enemy soldiers quickly perceive that such movement and the massing of forces, especially vehicles, are extremely dangerous.

The attacks would be designed to communicate clearly to enemy soldiers that movement makes them visible and very vulnerable to deadly air attacks that would soon follow if they attempt to move. Creating such a perception of extreme danger is very important because of soldiers' tendency to behave in a way that will minimize exposure to that danger. In this case, the desired "effect" is an enemy force whose soldiers will not risk vehicular movement. This behavior explains how one can achieve militarily significant vehicular paralysis faster and with fewer resources than might otherwise be expected from the physical destruction actually inflicted.

As the suppression of enemy air defenses (SEAD) operation in the Gulf War demonstrated, one can quickly create a sufficient perception of danger to achieve paralysis (or suppression) by beginning a campaign with large numbers of sudden and extremely lethal air attacks. One can maintain that perception by conducting prompt, lethal attacks against any enemy attempt to operate machines (move, mass, or emit). Making *persistent* vehicular paralysis a desired effect has the additional advantage of allowing component commanders and their staffs to assess quickly and reliably the success of precision engagements that target this movement. The theater C^2ISR team aids in this assessment with its ability to see in real time the location and amount of vehicular movement. With continuous coverage, the team's assessments will be even less subject to distortion by enemy CCD measures.

Ideally, the JFC's campaign guidance to the joint force land component commander (JFLCC) would be to support the JFACC's precision engagement with maneuver while also maneuvering to avoid close combat as much as possible. Under this guidance, the JFLCC would orchestrate maneuver to present such a threat or opportunity that creates the "effect" of causing enemy forces to attempt rapid and massive vehicular movement. Closely coordinated with the JFACC, such an effect would greatly increase enemy vulnerability to air attack. The resulting destruction of enemy forces attempting to move would, in turn, complement friendly land maneuver by quickly causing more long-lasting and widespread enemy vehicular paralysis and dispersal.

After the JFC determines that the combination of precision engagement and maneuver has achieved the degree of paralysis and dispersal of enemy forces that will provide friendly land forces with maneuver dominance, enemy units would become vulnerable to being bypassed or defeated in detail. Thus, regardless of whether an enemy commander chooses to move or disperse and conceal forces, the JFC's conduct of effects-based joint operations would dramatically reduce the role of close combat, while ensuring that enemy land forces face certain, quick defeat with minimum risk for civilians and friendly forces. Unable to fight effectively, organized enemy resistance likely would collapse rapidly, allowing US forces to quickly achieve the campaign's objective.

Airborne Battle Management and Effects-Based Joint Operations

The success of effects-based joint operations depends on airborne battle management. The JFACC would use the C^2ISR team to manage the decentralized execution of counterland operations that would target mobile forces within the team's coverage area. The JFACC would do this by using the air tasking order (ATO) to assign objectives, forces (fighters, bombers, armed helicopters, UAVs, and—in the future—unmanned combat air vehicles), and coverage areas to subordinate commanders located with their battle staffs on board the C^2ISR team's systems. One should emphasize that the use of the C^2ISR team's airborne battle management would be integrated into the JFACC's exercise of centralized control over theater air operations. The JFACC would remain responsible for developing the air portion of the theater campaign plan, based on JFC guidance, and coordinating that plan and its dynamic execution with the JFLCC.

The C^2ISR team's airborne battle staffs would be responsible for dynamically prioritizing targets and pairing weapons with targets, based on changing conditions created by vehicular movement and weather. They would be expected to create and then exploit opportunities and neutralize developing threats created by vehicular movement. For example, they might create an opportunity, such as a lucrative vehicle concentration, by targeting route structure just in front of a convoy when it reaches a location where the vehicles could not quickly disperse under a follow-up attack. Airborne battle staffs could also create opportunities by suggesting schemes for friendly land maneuver designed to make enemy forces move in ways that would increase their vulnerability to air attack. The JFACC would closely monitor this decentralized execution of the ATO, coordinating recommendations for land maneuver as necessary with the JFLCC. Perhaps as the result of new JFC guidance or dialogue with the JFLCC, the JFACC would make timely adjustments, as necessary, in terms of the objectives, coverage areas, and forces assigned to the airborne battle staffs.

One could compare the C^2ISR team's role in effects-based joint operations to that of a quarterback whom the coach (JFACC) allows to exercise his judgment and change plays (divert sorties and assign targets) at the line of scrimmage to counter developing threats or exploit fleeting opportunities. For example, a coach may instruct his quarterback to call an audible when necessary to counter developing threats or exploit opportunities created

by the location or movement of an opponent's defensive players. Like the quarterback calling an audible, when the C^2ISR team detects a developing threat or fleeting opportunity created by enemy vehicular movement, the JFAAC could authorize it to act quickly and divert aircraft previously identified as potential diverts in the ATO to appropriate targets.

Differences between Mobile and Fixed Targeting

The differences between the processes for the precision engagement of mobile and fixed targets help explain why one needs the C^2ISR team's decentralized airborne battle management to achieve the "single digit" response time required in effects-based joint operations. In contrast to engaging fixed targets, the precision engagement of mobile army forces requires minimizing the engagement-decision timeline because target movement can quickly change one or more factors vital to targeting effectiveness. One obvious factor vital to effectiveness is target movement's ability to change its location rapidly. Movement can also quickly reduce target vulnerability through dispersing, increasing the intervals between vehicles, changing the types of vehicles (armored versus soft skin) in the target area, and decreasing target exposure to attack by using terrain and foliage for protection and concealment. Movement can quickly reduce target size in terms of the numbers of vehicles in the target area and can rapidly increase the risk of collateral damage by adding civilian vehicles or by putting military vehicles into a populated area. Furthermore, the risk to friendly forces can increase quickly through movement. For example, enemy vehicles can move under the coverage of an air defense system, a missile launcher can reach a firing position, and enemy land forces can move into sufficient proximity to friendly land forces to employ their weapons.

Adding to the differences between the processes for precision engagement of fixed and mobile targets is the way vehicular movement can influence the complexity of the targeting process—for example, through the number and types of vehicles that are potential targets. The enemy could have thousands or even tens of thousands of different vehicles, military and civilian, moving in very dense traffic within the C^2ISR team's coverage area. Their unpredictable movement adds to targeting complexity. Unlike aircraft, vehicles on land can, and often do, frequently change their direction and speed, making unpredictable stops and starts while moving over a very short distance. Traffic density can also quickly change. Other reasons for the unpredictability of vehicular movement include the way darkness, adverse weather, traffic density, and changing surface strength (perhaps from weather or damage to a road) affect vehicle speeds. In addition, movement can affect targeting complexity by quickly changing surveillance coverage and visibility due to screening caused by terrain, foliage, and buildings.

Operational Factors and Airborne Battle Management

Timeless operational factors related to human capabilities and limitations provide still more reasons why airborne battle management is essential for effects-based joint operations. Even when battlefields were far smaller and commanders could see and quickly communicate (using horns, drums, and flags) with all their forces, effective commanders learned to organize by exercising command and control (C^2) through subordinate echelons (through commanders of tens, hundreds, thousands, and ten thousands). The limitations were not so much technical as human. These commanders knew, as do fighter pilots experienced in air-to-air combat, that their span of surveillance limited the number of dynamic entities and engagements that they could track, especially when the entities moved in many different and widely separated parts of the battle space. They also knew that their span of control limited the number of units they could effectively manage during a very dynamic engagement. Fi-

nally, they knew that the survival of their forces, let alone their ability to achieve success, depended on whether their exercise of C^2 would degrade gracefully due to interruptions in communications with the fighting forces or if they or a key subordinate became disabled.

The magnitude of the span-of-surveillance problem created by large numbers of mobile land targets has a significant impact on the airborne battle management of counterland operations. This problem makes it necessary for C^2ISR systems responsible for the execution of counterland operations to have large numbers of operator workstations. For example, on land—especially during the initial part of a campaign—there are likely to be more targets (thousands instead of tens or hundreds) to detect, locate, track, and characterize than in the air.

As has been noted, the movement of vehicles on land is much more complex than in the air, in that they move far more slowly and unpredictably, ensuring that they rarely move continuously or relatively directly between their starting points and destinations—as do aircraft. The ability of vehicles moving across the land's surface to stop moving at any time also creates increased opportunities for effective CCD—all of which makes reliable tracking and characterization far more difficult on land. Additionally, land vehicles often move in dense traffic and are more subject to screening. Finally, the fact that civilian vehicles are much more likely to be intermingled with military vehicles adds to the difficulty of characterizing and prioritizing targets on land.

Constraints on span of control also contribute to the need for C^2ISR systems large enough to support multiple numbers of attack-control operators. The much larger number of targets and the complexity of their movement do much to make span of control for the engagement of mobile land targets generally much more constrained than is the case with the engagement of air targets. Given the very large number of vehicles likely to be moving on land, especially during an enemy offensive or in a defensive reaction to a friendly offensive, effective precision engagement will likely require control of a large number of nearly simultaneous attacks.

But target movement is not the only factor constraining span of control on land. Span of control is limited because aircraft targeting moving land vehicles probably need more information from off-board sources than is the case with the engagement of targets in the air. This is so because aircraft attacking mobile land targets do not have a sensor for detecting and tracking vehicles from a significant distance, let alone tracking a vehicle moving during adverse weather. In addition, aircraft attacking land vehicles generally employ munitions that do not have their own sensors, as do air-to-air missiles, that allow them to guide on a moving target. The fact that attacking aircrews need to precisely aim their munitions at land targets can easily increase the amount of targeting information operators must provide to ensure an effective precision engagement.

A surface C^2 facility, such as an air operations center, usually located deep in friendly territory, needs airborne battle management to maintain timely contact with large numbers of aircraft operating deep in enemy airspace. Much of the dominant battle-space awareness needed to orchestrate precision engagements against mobile targets depends upon one's ability to monitor the communications of aircraft operating in enemy airspace.

Deployability and out-of-area "untethered" operations provide still more reasons for exercising airborne battle management. Increasingly, countering threats posed by land forces will require quickly deploying forces to areas where surface facilities for exercising C^2 are limited or unavailable. Even if such facilities are available, they and their communications are likely to be more vulnerable to attack—especially from ballistic or cruise missiles delivering weapons of mass destruction—than an airborne system. If necessary, one can base an airborne system at a significant distance from the area of operations, where it can maintain an orbit beyond the reach of an enemy's surface-based air defenses.

The Requirement for Advanced Distributed Simulation

The success of effects-based joint operations depends greatly on whether JFCs, their component commanders, and their subordinates—including the commanders and battle staffs located on board the C^2ISR team's systems—use advanced distributed simulation (ADS) to conduct realistic training, war planning, and mission rehearsal. ADS is essential because live peacetime exercises provide an extremely limited environment for learning how to most effectively employ C^2ISR systems that can detect, locate, track, and target very large numbers of vehicles moving in an unpredictable manner within a vast area. For example, cost constraints severely limit both the number of live exercises and the number of vehicles used in these exercises. Peacetime exercises also tend to be unrealistic because the majority of them are confined to familiar and relatively small operating areas that bear little similarity to areas where combat is likely. In addition, safety considerations can greatly constrain the realism of the peacetime training environment.

One also needs ADS because current models and simulations cannot show the full value of battle-space awareness provided by airborne ground surveillance and the need for airborne battle management to effectively exploit that awareness with timely precision engagements that complement and reinforce land maneuver. Problems have arisen from a limited ability to simulate realistically the surveillance and targeting of large numbers of moving vehicles. The lack of realism has extended to both visual displays and surveillance-control measures. Because they cannot realistically show the value of ground-surveillance systems' battle-space-awareness capabilities, current models and simulations do not provide the repetition needed for effective concept development, war planning, and mission rehearsal.

Fortunately, ADS can help solve the problems associated with both live exercises and current models and simulations. With ADS it is possible to have a scenario generator provide over a distributed interactive simulation network thousands of virtual vehicles, each of which can move realistically across any desired terrain according to a script written to replicate a specific doctrine. More importantly, ADS allows one to take virtual target information from the scenario generator and translate it into realistic target reports, as seen by the surveillance system, by introducing factors such as probability of detection, target location, false detection, and terrain-screening effects. Displayed on a C^2ISR system's operator workstations, these reports are indistinguishable from "live" action.

Since ADS makes it possible to fight realistic scenarios located anywhere in the world and provide repetition, theater commanders could easily use ADS for war planning. With ADS, they could assess a variety of different campaign options. Similarly, battle staffs on board the C^2ISR team could use ADS for mission rehearsal, even en route to a contingency. Moreover, by allowing realistic training without having to fly the C^2ISR team and conduct live target attacks, ADS could significantly reduce training costs, wear and tear on actual C^2ISR systems, and the impact of operations tempo on their crews.

Challenges to Implementing Effects-Based Joint Operations

Although implementing effects-based joint operations provides important advantages, it also poses numerous challenges for the services. Given the critical role played by the C^2ISR team, implementation would require that the services solve the current low density/high demand problem by procuring sufficient numbers of C^2ISR systems so that a team can place vital areas under continuous coverage well before aggression or internal oppression begins. The team's vital role also means that the services must accelerate their efforts to provide these systems with enhancements that improve the quality of the team's information and its ability to use that information to support dynamic targeting.

Since models play a major role in determining equipment requirements, the services must develop new war-fighting models that treat an enemy's fielded land forces as a system whose ability to function depends upon the operation of its machines. The models must show how all vehicles, not just tanks, influence an army's war-fighting effectiveness. They must also show with realism the way people actually behave in war—behavior that is vastly different from how an opposing force's "entities" act in current attrition-oriented models.

Forces fight as they train. Therefore, it is essential that the services train together more frequently and more realistically. Effective training for the C^2ISR team and the services' air forces requires an opposing force fielded in appropriate numbers and employing intensive CCD measures. Scenarios should also include the use of simulated civilian vehicles. In contrast to what they do in today's training, Army and Marine Corps forces must design their land maneuver to make US air forces more effective at targeting opposing forces without becoming engaged in costly close combat. Also of great importance, training must be conducted in realistic terrain and weather conditions.

Finally, the successful implementation of effects-based joint operations requires that US commanders and their staffs be well qualified to conduct war at the operational level. The services must treat qualifications for this level with the same thoroughness that they currently apply to those for the tactical level. As is the case with tactical-level units, the services must demand that all personnel, regardless of rank, demonstrate appropriate knowledge and judgment at the joint operational level before assigning them war-fighting responsibilities. □

Domestic policy can only defeat us; foreign policy can kill us.

—John F. Kennedy, 1961